BMI Percentile Does Not Affect Performance on Functional Testing and Patient Reported Outcomes at 6- and 9-Months Following Anterior Cruciate Ligament Reconstruction in Young Patients

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INTRODUCTION:

Recovery following Anterior Cruciate Ligament reconstruction (ACL-R) requires restoration of knee strength, stability, and range of motion before patients can return to physical activity. Return-to-sport (RTS) testing protocols typically combine measurements of strength and functional testing as well as patient reported outcome measures (PROs) to determine readiness for sports clearance. Elevated body mass index (BMI) is associated with increased risk of additional intraarticular injuries and concomitant procedures at the time of ACL surgery. Studies in adults suggest that patients who are obese have significantly lower patient reported outcomes at minimum 1 year following ACL-R. The present study aims to explore the relationship between BMI percentile and RTS outcome measures in patients < 21 years of age after ACL-R surgery.

METHODS:

A retrospective chart review was conducted to include patients 13-20 years of age who had primary ACL-R and underwent RTS testing. The study included 67 patients (36M and 31F) with 89 RTS tests completed. Multi-ligamentous injuries, revision ACL, and ACL-R performed at other hospitals were excluded. Assessments were conducted at either 6 months (n=33) or 9 months (n=56) post-operatively (post-op); 22 patients completed RTS tests at both time points. Extreme outliers (> 3 SD) were excluded for each RTS outcome measure. Patients were categorized into two BMI percentile groups (Table I), using CDC guidelines: normal weight (NBP, 5th–85th percentile) and overweight (OBP, ≥85th percentile) (Centers for Disease Control and Prevention, 2024).

Physical performance measures included limb symmetry index (LSI) of quadriceps strength, hamstring strength, Y-balance composite, and single-leg hop tests. PROs included the ACL-Return to Sport after Injury (ACL-RSI) scale and the Pediatric International Knee Documentation Committee (Pedi-IKDC) survey. Subgroup analyses were conducted based on BMI percentile category and RTS test interval (6 or 9 months). A Shapiro-Wilk test was completed to check for normality within the data. Data that did not follow normality were statistically analyzed through a nonparametric Mann-Whitney U-test. Two sample t-tests were run for data that passed the Shapiro-Wilk normality test. The T-test and Mann-Whitney U-test were used to compare RTS outcomes between groups (α = 0.05), with Bonferroni correction applied for multiple comparisons of physical (adjusted α = 0.0125) and patient reported (adjusted α = 0.025) measures.

RESULTS: Physical and patient reported RTS measures at both 6- and 9-months post-op were not significantly different between normal and overweight BMI percentile groups. While both cohorts demonstrated improvements in test scores from 6 to 9 months, patients in the OBP group had no significant difference in physical outcomes from 6 months to 9 months post-op. However, the PEDI-IKDC ($p < .001$) and ACL-RSI ($p = .005$) scores significantly improved in the OBP group from 6 to 9 months (Figure 1,2). Patients in the NBP group demonstrated significant improvements from 6 to 9 months post-op in ACL-RSI ($p < .001$), PEDI-IKDC ($p < .001$), LSI quad strength ($p = .012$) and single-leg hop ($p < .001$). No other RTS measures showed significant changes in this group.

DISCUSSION AND CONCLUSION: BMI percentile did not significantly impact physical and patient reported outcomes following ACL-R in pediatric patients at 6- and 9-months post-op. While both BMI groups showed improvement in self-reported knee function and psychological readiness over time, only patients in the normal weight group demonstrated significant increases in quad strength, and single-leg hop performance. Meanwhile, overweight patients showed no significant change in strength and functional testing over time. These findings suggest that while BMI may influence certain aspects of recovery, it should not be viewed as a significant barrier to successful recovery and return to sport in young patients. Instead, BMI should be integrated as a factor in individualized rehabilitation plans and in setting realistic expectations for recovery and RTS timelines.
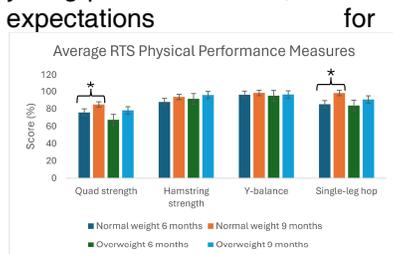

Figure 1: RTS average scores for physical performance measures. Both BMI percentile groups at each time point were plotted. Asterisk (*) indicates groups that were significantly different during statistical comparisons.
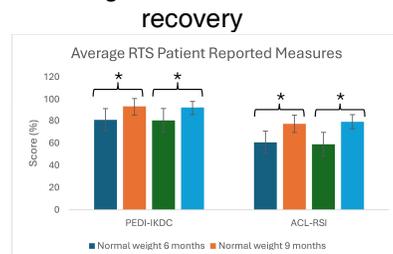

Figure 2: RTS average scores for patient reported measures. Both BMI percentile groups at each time point were plotted. Asterisk (*) indicates groups that were significantly different during statistical comparisons.

BMI Percentile Group	6 months post-op	9 months post-op
Normal (NBP)	29	27
Overweight (OBP)	15	18

Table I: Number of RTS tests stratified by post-op time interval (6 or 9 months) and BMI percentile group (normal or overweight).